

GCSE Chemistry (9 – 1)

Chemistry of the Atmosphere

Name:

Group:



Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.

For markers use	
Question	Mark
1	/5
2	/12
3	/6
4	/6
5	/9
6	/6
Total	/44
%	
Grade	

Information

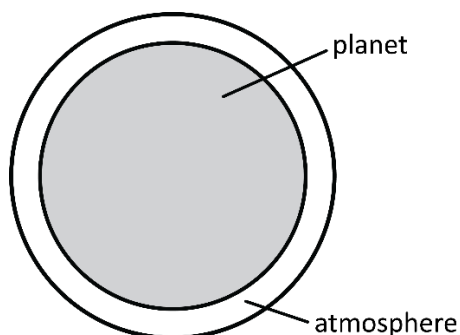
- The maximum mark for this paper is 44 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. The chemistry of the atmosphere explores the 4.6 billion year story of the air we breathe, tracing its evolution from early volcanic origins to the modern-day impact of pollutants and greenhouse gases on our climate.

Circle the letter of the correct answer for each of the following questions.

- a) A space probe has analysed the atmosphere of a newly discovered moon.
The table below shows the composition of its atmosphere:



Gas	Percentage by Volume
Carbon Dioxide	0.03
Nitrogen	90
Oxygen	9

Which gas is present in the moon's atmosphere in a **higher** percentage than it is in the Earth's atmosphere?

A

Carbon dioxide only.

B

Nitrogen only.

C

Nitrogen and oxygen.

D

Oxygen only.

(1 mark)

- b) Which gas was the most abundant in the Earth's early atmosphere?

A

Carbon dioxide.

B

Nitrogen.

C

Oxygen.

D

Sulfur dioxide.

(1 mark)

- c) Which biological process is responsible for the gradual increase of oxygen in the Earth's atmosphere over the last 2.7 billion years?

A

Respiration by animals

B

Volcanic eruptions

C

Photosynthesis by
algae and plants

D

Combustion of fossil
fuels

(1 mark)

- d) An article about climate change in a newspaper made the following claims about carbon dioxide. Carbon dioxide can be produced by the following:

1	As a product of respiration.
2	As a product of methane burning in air.
3	When calcium carbonate reacts with hydrochloric acid.

Which of these statements are correct?

A

B

C

D

1 and 3

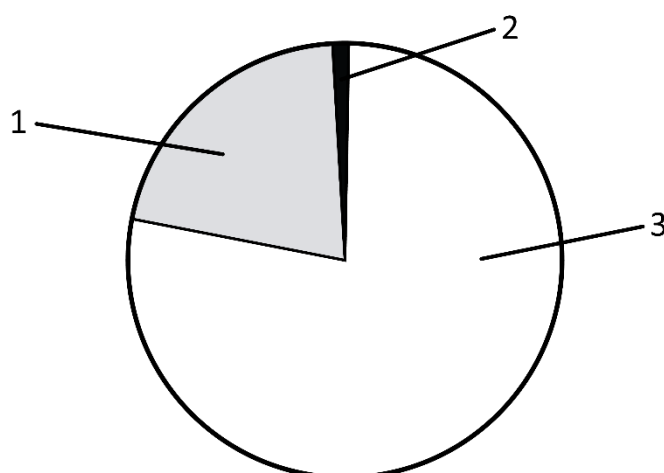
1 only

1 and 2

All of the above

(1 mark)

- e) The pie chart below shows the percentages of different gases in the Earth's atmosphere today. Which row of the table identifies gases 1, 2, and 3 correctly?



	1	2	3
A	Nitrogen	Oxygen	Other gases
B	Other gases	Oxygen	Nitrogen
C	Oxygen	Other gases	Nitrogen
D	Oxygen	Nitrogen	Other gases

(1 mark)

(Total for Question 1 is 5 marks)

2. As the Earth aged, the temperature of the planet dropped significantly, allowing liquid water to exist. Later, the evolution of simple organisms like algae utilised sunlight to produce energy.

a) State how the drop in the temperature of the planet affected the amount of water vapour in the early atmosphere.

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(1 mark)

b) Explain how the process of photosynthesis in early organisms altered the percentage of carbon dioxide and oxygen in the air.

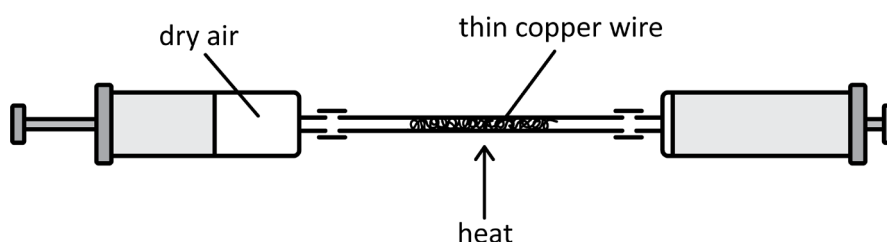
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(2 marks)

A chemistry teacher performs a demonstration to determine the percentage of oxygen in the atmosphere.

She places a pile of pink-brown copper powder inside a horizontal glass tube connected to two gas syringes. She heats the copper strongly with a Bunsen burner while pushing the plungers in and out to pass the air over the hot metal.

The apparatus she uses is shown below:



The total volume of air in the syringes at the start is 50 cm^3 .

c) Given that dry air contains 21% oxygen, calculate the volume of gas that will be left in the apparatus once all the oxygen has reacted with the copper.

Assume the final volume is measured after the apparatus returns to room temperature.

Final volume = ...

(2 marks)

d) Write the **balanced** chemical equation for the reaction of copper with oxygen in the tube.

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(3 marks)

e) After the teacher had finished her demonstration a large volume of gas remained in the tube. This gas does not react with the copper and remains as the primary component of the gas syringe after cooling.

Identify this gas.

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(1 mark)

f) A student carries out the same experiment as the teacher but calculates the percentage of oxygen in the air to be 15%. This is lower than the expected value of 21%.

Suggest **three** practical reasons why the final volume of gas collected was higher than it should have been.

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(3 marks)

(Total for Question 2 is 12 marks)

3. Scientists think that the Earth's early atmosphere was formed by volcanic activity and was very similar to the atmosphere of Mars today.

The table below shows the composition of the atmosphere on Mars.

Gas	Percentage by Volume
Carbon Dioxide	95.0
Nitrogen	3.0
Oxygen	0.1
Argon	1.6

- a) Using the data in the table and your knowledge of the Earth's atmosphere today, describe two major changes that have happened to the gas composition of Earth's atmosphere over the last 4.6 billion years.

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(2 marks)

The Earth's early atmosphere contained a large amount of water vapour.

As the Earth cooled, this water vapour played a key role in reducing the levels of carbon dioxide.

- b) Explain how the cooling of the Earth led to a decrease in atmospheric carbon dioxide.

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(3 marks)

- c) Much of the carbon from the early atmosphere is now "locked up" in the Earth's crust.

Name one type of sedimentary rock formed from carbon dioxide

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(1 mark)

(Total for Question 3 is 6 marks)

4. The table below compares the atmosphere of the planet Venus today with the atmosphere of the Earth today.

Gas	Percentage in Venus's Atmosphere (%)	Percentage in Earth's Atmosphere (%)
Carbon Dioxide	96.5	0.04
Nitrogen	3.5	78.0
Oxygen	0.00	21.0

Scientists believe that billions of years ago, the Earth's early atmosphere was very similar to the atmosphere of Venus today.

Describe the changes that have taken place in the Earth's atmosphere over time and explain the processes that caused these changes.

In your answer, you should refer to:

- How the level of carbon dioxide decreased.
- How the level of oxygen increased.

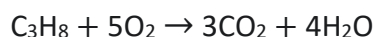
[illegible]

(6 marks)

(Total for Question 4 is 6 marks)

5. Propane (C₃H₈) is a hydrocarbon fuel often used for heating.

When propane burns completely, it reacts with oxygen in the air to produce carbon dioxide and water.
The equation for the reaction is:



A canister contains 1.10 g of propane.

- a) Calculate the minimum volume of air required to completely burn this sample of propane at room temperature and pressure.

Assume that dry air contains 21.0% oxygen by volume.

(Molar volume of a gas at r.t.p. = 24.0 dm³/mol)

Give your answer in dm³ and to **3 significant figures**.

Volume of air = ... dm³
(5 marks)

- b) Most fossil fuels, such as coal, contain sulfur as an impurity.

Explain how burning these fuels causes acid rain to be produced, and state one adverse effect of acid rain on the environment.

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(4 marks)

(Total for Question 5 is 9 marks)

